# FIELD TEST FOR BERYLLIUM

By W. M. Dressel and R. A. Ritchey

* * * * * * * * * * * * information circular 7946

UNITED STATES DEPARTMENT OF THE INTERIOR
Fred A. Seaton, Secretary

BUREAU OF MINES
Marling J. Ankeny, Director

Generated on 2024-09-22 01:35 GMT / https://hdl.handle.net/2027/osu.32435030643365
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

This publication has been cataloged as follows:

**Dressel, Waldemar Martin.**

Field test for beryllium, by W. M. Dressel and R. A. Ritchey. [Washington] U.S. Dept. of the Interior, Bureau of Mines [1960]

5 p. illus. 26 cm. (U.S. Bureau of Mines. Information circular 7946)

1. Beryllium. I. Ritchey, Roy Austin, joint author. II. Title. (Series)

TN23.U71 no. 7946 622.06173

U.S. Dept. of the Int. Library

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington 25, D.C. - Price 15 cents

Generated on 2024-09-22 01:32 GMT / https://hdl.handle.net/2027/osu.32435030643365
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Digitized by Google

Original from
THE OHIO STATE UNIVERSITY

## CONTENTS


| | Page |
|---|---|
| Summary | 1 |
| Introduction | 1 |
| Apparatus | 2 |
| Reagents | 3 |
| Procedure | 4 |


## ILLUSTRATION


| Fig. | | |
|---|---|---|
| 1. | Apparatus used in making field test for beryllium | 3 |


Generated on 2024-09-22 01:39 GMT / https://hdl.handle.net/2027/osu.32435030643365
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Digitized by Google

Original from
THE OHIO STATE UNIVERSITY

# FIELD TEST FOR BERYLLIUM[1/]

by

W. M. Dressel[2/] and R. A. Ritchey[3/]

## SUMMARY

A simple, reliable field test for beryllium in rocks has been developed by the Rolla Metallurgy Research Center of the Federal Bureau of Mines. A small portion of the pulverized rock is fused with a sodium carbonate-sodium hydroxide flux in a wire loop. The fused mass is dissolved in water, a few drops of quinizarin solution are added, and the solution is viewed under ultraviolet light. A pink-to-orange fluorescence reveals the presence of beryllium in a sample containing as little as 0.013 percent beryllium (0.26 percent beryl).

## INTRODUCTION

New and potential uses for beryllium make necessary a more intensive search for this metal, which is so similar to aluminum in its chemical reactions that it is not separated from aluminum in ordinary chemical analyses. The principal ore mineral of beryllium is beryl, a beryllium-aluminum silicate, which contains only 5 percent beryllium. This mineral is so similar to quartz in appearance that it is not always possible to distinguish one from the other in the field. While the distinction may be made easily with a petrographic microscope, few prospectors have access to such an instrument, and fewer still know how to use it.

The development of a simple method for detecting the presence of beryllium may lead to the discovery of beryllium in rocks and minerals not previously suspected to contain this element. Therefore, the Bureau's Rolla Metallurgy Research Center at Rolla, Mo., undertook to develop a simple, reliable, and sensitive method for detecting beryllium in the field by those not trained in analytical chemistry.

This field test is an adaptation of a laboratory test for beryllium reported by Fletcher and White,[4/] of the College Park Metallurgy Research Center of the Bureau of Mines. It is based upon the fact that a pink-to-orange fluorescence will be emitted when a solution containing beryllium ions is treated with quinizarin and viewed in the dark under ultraviolet light of either the "long" or "short" wavelength type. As little as 0.013 percent beryllium (0.26 percent beryl) can be detected by this method, as tested on samples prepared

---

1/ Work on manuscript completed May 1959.
2/ Metallurgist, Bureau of Mines, Region IV, Rolla, Mo.
3/ Physical science aid, Bureau of Mines, Region IV, Rolla, Mo.
4/ Fletcher, Mary, and White, Charles E.: A Simple Test for the Detection of the Beryllium Minerals: Am. Miner., vol. 31, 1946, pp. 82-83.

Generated on 2024-09-22 01:40 GMT / https://hdl.handle.net/2027/osu.32435030643365
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

from weighed amounts of beryl, quartz, feldspar, and other minerals known to occur in association with beryl in its common host rock, granite pegmatite.

## APPARATUS

Individual items of the apparatus needed to detect beryllium in rocks and minerals cannot be obtained from the Bureau but can be bought from dealers in laboratory supplies. The most expensive piece of equipment is a source of ultraviolet light. It is likely that most of the required equipment in the following list will already be in the prospector's kit:

1. Safety glasses.
2. Crushing equipment, such as a hammer and anvil, a plattner mortar, or a mortar and pestle.
3. Heat source: An alcohol or propane torch, burner of a camp stove, or alcohol lamp and blowpipe.
4. Wire: Preferably platinum, 22 to 26 gage; but a loop made out of an iron, nickel, chromel, or alumel wire may be used.
5. Holder for wire: This may be made from a piece of soft glass tubing or rod, one-eighth inch in diameter and 3 inches long, by softening one end of the glass in a flame and inserting the hot end of the wire.
6. Test tube, 16 by 150 mm., glass.
7. Test-tube holder.
8. Test-tube brush.
9. Graduated cylinder, 10 ml., glass or polyethylene.
10. Spot plate of white porcelain.
11. Teaspoon or measuring spoon.
12. Funnel, small glass or polyethylene, for filtering.
13. Filter paper.
14. Dropping bottle, glass or polyethylene.
15. Ultraviolet light with a dominant wavelength of 3,660 A. or 2,537 A. (The usual precautions in using ultraviolet light should be observed. Ultraviolet light is particularly harmful to the eyes.)

The apparatus used in conducting the test is shown in figure 1. Polyethylene, because it is shatterproof, is recommended instead of glass for all the containers, except the test tube, which must be heated.

Generated on 2024-09-22 01:28 GMT / https://hdl.handle.net/2027/osu.32435030643365
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

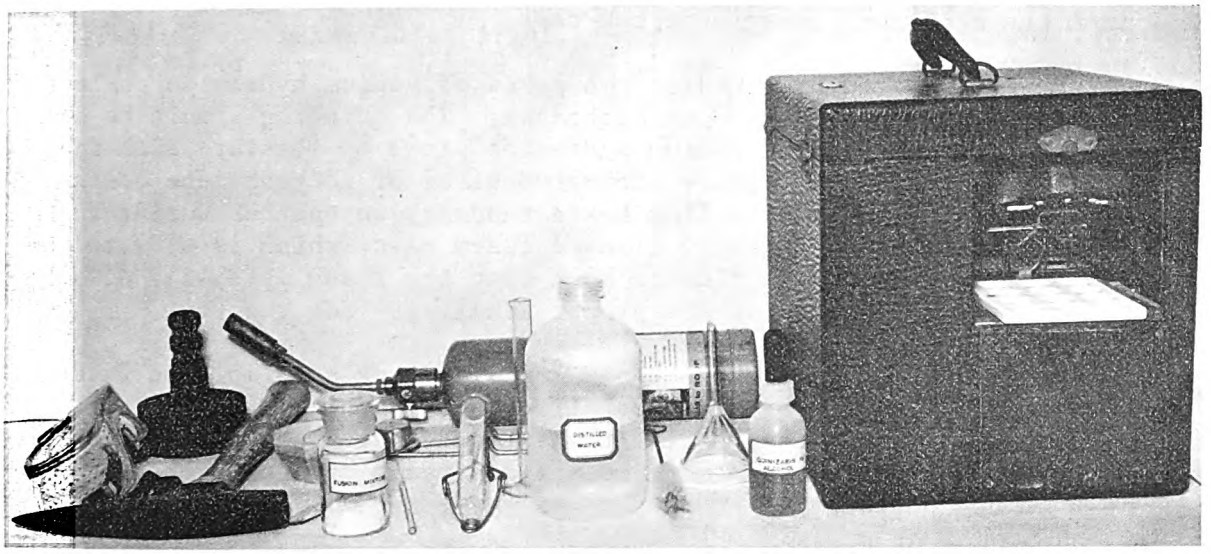

FIGURE 1. - Apparatus Used in Making Field Test for Beryllium.

## REAGENTS

The few reagents required for the test may be obtained from dealers in laboratory chemicals. These reagents are:

1. Quinizarin (1-4 dihydroxyanthraquinone, technical grade, 250 grams). (Note that this is not quinalizarin, which is another reagent sometimes used to detect beryllium.)

2. Alcohol (ethyl or methyl, 250 ml.).

3. Sodium hydroxide (pellets, one-quarter pound).

4. Sodium carbonate (anhydrous, one-quarter pound).

5. Water (preferably distilled, or water low in metallic ions, particularly calcium).

The quinizarin is used in solution. It is prepared by adding about one-quarter teaspoon of the powdered reagent to 25 ml. of alcohol, either ethyl or methyl, and allowing the reagent to stand for several hours, to form a saturated solution. The solution is then filtered to remove the excess of solid, and the filtrate is diluted with four times as much alcohol. The reagent is carried in a glass-stoppered or polyethylene dropping bottle. It must not come in contact with rubber or with oil, such as the oil of the skin, since these yield their own fluorescent colors in ultraviolet light. The reagent should be kept out of direct sunlight or intense electric light.

The sodium hydroxide must be kept in a tightly stoppered bottle. Pellets are convenient to use. Sodium hydroxide, also known as caustic soda or lye,

Generated on 2024-09-22 01:28 GMT / https://hdl.handle.net/2027/osu.32435030643365
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

should not be touched with the hands. It is corrosive, and it also will pick up oil from the skin and contaminate the test.

A flux is prepared by grinding two parts of sodium hydroxide pellets with three parts of anhydrous sodium carbonate. The grinding should be done as rapidly as possible because sodium hydroxide picks up moisture from the air. The flux is kept in a tightly stoppered glass or polyethylene container. Sodium hydroxide used alone as a flux has a tendency to spatter during fusion, and sodium carbonate used by itself gives a fused mass, which is slow to dissolve. The composition of the flux is such that the fused mass will dissolve in water and yield a solution of the proper alkalinity for the test.

The water used to dissolve the fused mass need not be distilled water, but it must be soft, that is, low in metallic ions, particularly in calcium ions, which tend to weaken the test. It was found that local tapwater could be used after it was boiled, and many mountain streams probably contain water pure enough to use directly.

A blank test, using only the reagents and water without using any known beryllium-containing material, should be run to ascertain that nothing is present in the materials used that will give a false indication. Tests using known amounts of the beryllium-bearing mineral being sought should be run to become familiar with the test and to ascertain the sensitivity of the method.

## PROCEDURE

A test is no better than the sample used. Proper selection of the sample is especially important in this beryllium test, since such a small amount of material actually is used in making the test. Select enough material from the outcrop to provide a representative sample. Use safety glasses to protect the eyes from flying particles. Crush, grind, and quarter the original sample until it is reduced in size so that it can be pulverized in a mortar or ground on an anvil with a hammer. The final sample should be flourlike in fineness.

Make a small loop, about 5 mm. (one-quarter inch) in diameter, on the end of the wire. Heat the loop to redness in a flame. Insert the hot loop in the flux, and then return it to the flame, repeating the procedure until a bead is built up in the loop. Now touch the hot molten bead to the pulverized rock sample, and fuse the adhering powder in the bead until the sample is dissolved completely.

Insert the wire carrying the bead into the test tube, and add 5 to 10 ml. water. Warm the water in the test tube to dissolve the bead. Remove the wire, cool the solution, and add 10 drops (0.25 ml.) of the dilute quinizarin solution. A purple- or lilac-colored solution should result.

Pour a small amount of this solution (1 to 2 ml.) into one of the cavities of the white porcelain spot plate and examine it in a darkened room or in a viewing chamber under either long or short wavelength ultraviolet light. A pink-to-orange fluorescence indicates the presence of beryllium. The exact

Generated on 2024-09-22 01:33 GMT / https://hdl.handle.net/2027/osu.32435030643365
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

color depends on several factors, including the amount of beryllium present, the quality of the ultraviolet light, and the container holding the test solution. Pure beryl gives a decided fluorescence. One percent of beryl or helvite in a rock yields a very distinct fluorescent color, one-half percent of these minerals yields a fainter but still distinct color, while in a simple rock composed almost entirely of quartz and feldspar as little as one-fourth percent of beryl can be detected.

Some attention was given to the influence of biotite, hornblende, pyrite, and other iron-bearing minerals on the test. These minerals do not interfere with the test when present to the extent to which they normally are found in beryl-bearing pegmatites. When more than 5 percent of pyrite is present, the test does not permit the certain detection of 1 percent or less of beryl, but 2 percent beryl gives a positive test in samples containing as much as 98 percent pyrite.

Lithium minerals occurring in pegmatites, such as lepidolite and spodumene, do not interfere with the detection of beryllium. High concentrations of calcium minerals in the samples have no effect upon the sensitivity of the test, although a high concentration of calcium in the water used must be avoided.

If the amount of powder dissolved in the bead is always the same and if the testing procedure is standardized, the intensity of the fluorescent color may be used to estimate the tenor of the beryllium-bearing rock.

The entire test requires very little material. It is positive and sensitive enough to detect as little as 0.013 percent beryllium (0.26 percent beryl) in a rock. It can be made in 5 minutes. These are important advantages over other tests for beryllium.

U.S. GOVERNMENT PRINTING OFFICE : 1960 O—534419

Generated on 2024-09-22 01:38 GMT / https://hdl.handle.net/2027/osu.32435030643365
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY